

Appl. No. 10/709,982
Amdt. dated June 29, 2006
Reply to Office action of March 31, 2006

REMARKS/ARGUMENTS

Reconsideration of this application and favorable action are solicited. Claims 1-12 remain active in the case.

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1. Interview summary:

A telephone interview was held between Patent Agent Scott Margo (Reg. No. 56,277) and Examiner Thanh T. Nguyen on June 13, 2006. Claims 1 and 8 were discussed.

10 Claims 1 and 8 were rejected as being anticipated by the Admitted Prior Art (APA). Below is a summary of the telephone interview.

Mr. Margo explained to the examiner that claim 1 recites executing a first CVD process to deposit a first low-k dielectric film, which is followed by a first cooling process. Next, a second CVD process is performed, followed by a second cooling process.
15 Claim 8 recites executing multiple CVD cycles, wherein each of the CVD cycles comprises depositing a low-k dielectric film with a CVD process followed by cooling down the low-k dielectric film.

On the other hand, the APA teaches in paragraph [0006] depositing a low-k dielectric film and performing a cooling process, but does not teach depositing a second
20 low-k dielectric film on the first low-k dielectric film and then performing a second cooling process for the second low-k dielectric film. Mr. Margo explained to the examiner that the additional intermediate cooling steps provide the advantage of reducing the internal stress of the low-k dielectric film.

The examiner said that she agrees that the APA does not teach the additional cooling
25 steps, but would like the record to show more clearly that executing multiple CVD cycles produces unexpected results that are different from what would be expected from producing a thicker dielectric layer using multiple steps.

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2. Rejection of claims 1-12:

Claims 1-12 were rejected under 35 U.S.C. 103(a), for reasons of record that can be
5 found on pages 2-4 in the Office action identified above.

It is one kernel feature of the claimed invention that the multiple-cycle CVD low-k
film deposition is employed to deposit a layer of low-k film with reduced stress. Each of
the CVD cycles comprises: (1) chemical vapor depositing a low-k dielectric film having a
pre-selected thickness; and (2) cooling down the low-k dielectric film within the CVD
10 reactor. In a case that the low-k film is deposited by using three CVD cycles, for example,
referring briefly to FIG. 7 of the present application, it is noteworthy that the low-k
dielectric film 14a undergoes three-time cooling steps, the low-k dielectric film 14b
undergoes two-time cooling steps, while the low-k dielectric film 14c undergoes one-time
cooling step.

15 The present invention provides a significant reduction in internal stress of the CVD
low-k film. The prior art adhesion problem can be solved and the device reliability is
improved. Please refer to FIG. 9 of the present application. FIG. 9 is a comparison plot
showing the internal stress (MPa) vs. thickness (kilo-angstrom) of the CVD low-k film,
wherein experimental results regarding both prior art one-step CVD deposition and the
20 multi-stage CVD deposition are demonstrated. As seen in FIG. 9, a one-step CVD low-k
film with a desired thickness of 0.45 microns (4.5 kilo-angstroms) has an internal stress or
residual stress of about 42 MPa. Compared to the prior art one-step CVD low-k film, the
present invention multi-stage CVD low-k film with a desired thickness of 0.45 microns
has a much lower internal stress of about 15 MPa. (See Para. [0026] and Para. [0027])

25 In light of the above, the applicant submits that none of the cited references, alone or
in combination, teaches or makes obvious all of the limitations of "executing a second
CVD process within the CVD reactor to deposit a second low-k dielectric film having the
pre-selected thickness onto the first low-k dielectric film; executing a second cooling

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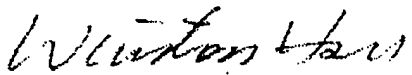
process within the CVD reactor for cooling down the first and second low-k dielectric films, wherein the first and second low-k dielectric films constitute a low-k film stack having reduced internal stress", and "executing multiple chemical vapor deposition (CVD) cycles within a CVD reactor to deposit a low-k dielectric film stack on the first dielectric barrier until thickness of the low-k dielectric film stack reaches a desired value, wherein each of the CVD cycles comprises: (1) chemical vapor depositing a low-k dielectric film having a pre-selected thickness; and (2) cooling down the low-k dielectric film within the CVD reactor", as required in claims 1 and 8, respectively. The applicant believes that claims 1 and 8 are allowable. Reconsideration of claims 1 and 8 is therefore politely requested.

As claims 2-7 and 9-12 are dependent on claims 1 and 8, respectively, they should be allowed if claims 1 and 8 are allowed

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

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Sincerely yours,



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Note: Please leave a message in my voice mail if you need to talk to me. (The time in D.C. is 12 hours behind the Taiwan time, i.e. 9 AM in D.C. = 9 PM in Taiwan.)